

## **Optics of the NIFS Negative ion source test stand by infrared calorimetry and numerical modeling**

P. Veltri<sup>1</sup>, V. Antoni<sup>1</sup>, P. Agostinetti<sup>1</sup>, M. Brombin<sup>1</sup>, K. Ikeda<sup>2</sup>, M. Kasaki<sup>2</sup>, H. Nakano<sup>2</sup>, E. Sartori<sup>1</sup>, G. Serianni<sup>1</sup>, Y. Takeiri<sup>2</sup> and K. Tsumori<sup>2</sup>

<sup>1</sup>*Consorzio RFX (CNR, ENEA, INFN, Università di Padova, Acciaierie Venete SpA) Corso Stati Uniti 4, 35127 Padova, Italy*

<sup>2</sup>*National Institute for Fusion Science, 322-6 Oroshi, Toki, Gifu 509-5292, Japan*

*Corresponding Author: Pierluigi Veltri, e-mail address: [pierluigi.veltri@igi.cnr.it](mailto:pierluigi.veltri@igi.cnr.it)*

At the National Institute for Fusion Science (NIFS, Japan), neutral beams with the energy up to 15 MW are routinely injected to the hydrogen plasma confined in the Large Helical Device (LHD) using three negative ion beam-lines[1]. Together with the heating beam-lines, a test stand beamline is also operated at NIFS, to gain a better understanding of the physics regulating the formation, extraction and acceleration of negative ions, and their conversion to neutrals. The test stand is based on a 1/3-scaled negative ion source of the same arc-driven source adopted for the LHD beamline, and its acceleration system is a standard triode. The electrode grids are divided into 2 segments having slightly different geometries of the intermediate steering grid (SG) and a common multi slotted grounded grid. In this paper the beamlet optics of both systems was studied by means of an instrumented calorimeter [2] made of carbon fibre composite (CFC) tiles; the tiles were constructed making the propagation of thermal energy along the beam direction largely dominant with respect to the other directions, so that the thermal pattern on the rear plane of the tile has a strong correlation with the power profile deposited by the beamlets on the beam-facing plane of the tile. Infrared image of this thermal pattern is analysed to study the beamlet characteristics obtained in different source conditions [3]. The experimental measurements are then compared with 3D numerical simulations, in order to validate the codes, and to assess their degree of reliability. The simulations show a satisfactory agreement with the experimental results; some minor discrepancies are highlighted and their possible causes are addressed in the manuscript.

**Acknowledgement** Contribution by Consiglio Nazionale delle Ricerche and Japan Society for the Promotion of Science is acknowledged. This work was set up in collaboration and financial support of F4E.

### **References**

- [1] Y. Takeiri et al., AIP Conf. Proc., Vol. 1515 Issue 1, p139 (2013)
- [2] G. Serianni et al., AIP Conf. Proc., Vol. 1515 Issue 1, p579 (2013)
- [3] V. Antoni et al., AIP Conf. Proc. Vol. 1655, 060005 (2015)